

# **FUTURE PEACEFUL NUCLEAR TECHNOLOGY APPLICATIONS**

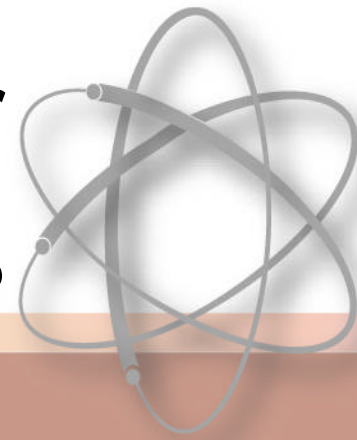
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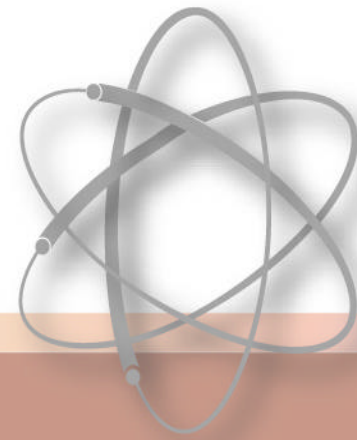
**CENTER FOR GLOBAL SECURITY RESEARCH**

# Future Peaceful Nuclear Technology Applications



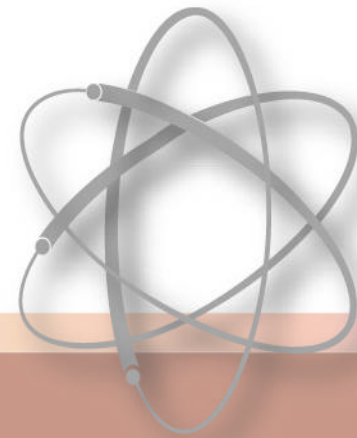
- Present status
- Future needs
- Future prospects
  - Potential ability to satisfy needs
  - Problems inhibiting realization
- What should be done to shape the future

# Existing Nuclear Power Capacity



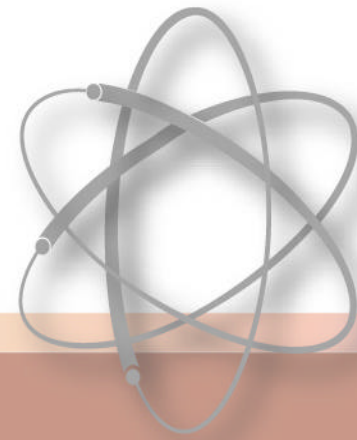
- **441 nuclear plants worldwide, providing 16% of world's electricity**
- **32 plants under construction, most in Asia**
- **Many countries depend critically on nuclear contribution to electricity generation:**
  - Western Europe ~37%; France 77%
  - U.S. 20%, 5 of its States 50% or more
  - Japan 30% and Korea 37%
- **Some countries (U.K., France, Russia) use nuclear fuel recycle**

# Nuclear Power Safety, Reliability, Cost



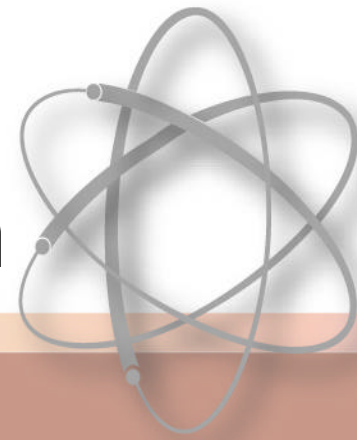
- **Substantial improvements in last decade**
- **Average capacity factor of U.S. plants at record levels: >90% in 2002**
- **Production costs of present plants in US: 1.71 cents/kWe in 2002; 1.68 cents/kWe in 2001, a record low**
- **INPO and NRC safety/performance indicators trend upward**

# Nuclear Power Proliferation Problems



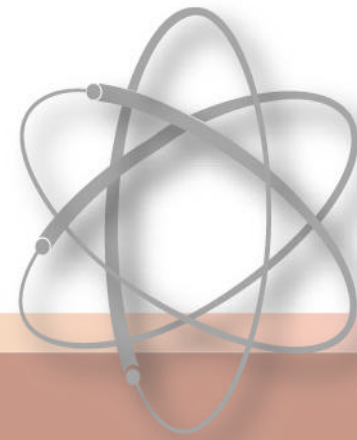
- **Nuclear weapon development pursued under cover of nuclear power:**
  - Enrichment facilities (HEU) and research reactors with separation of Pu
  - Military technology primarily applied
- **Export controls evaded**
- **No known diversion of weapon-usable material from safeguarded civilian applications since inception of IAEA**

# Nuclear Power Aids Nuclear Weapons Disposition



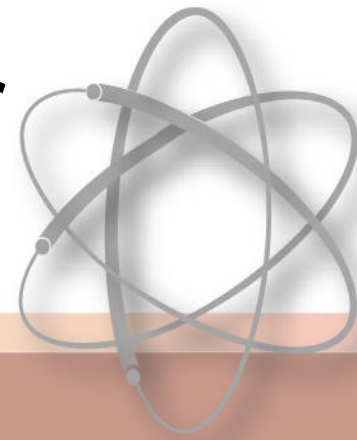
- **U.S. nuclear power plants used to dispose of excess weapon material as reactor fuel**
- **Equivalent of 7,000 HEU nuclear warheads disposed of to date in US power plants**
- **Program initiated to dispose of excess Pu as fuel in US and Russian power plants**

# Non-Power Applications of Nuclear Technology



- Medicine
- Agriculture: New crops, food processes
- Industrial applications
- Environmental protection
- Research reactors and critical facilities
- Public safety
- Space power

# Impact of Non-Power Nuclear Technology



**Economic impact greater than nuclear power:**

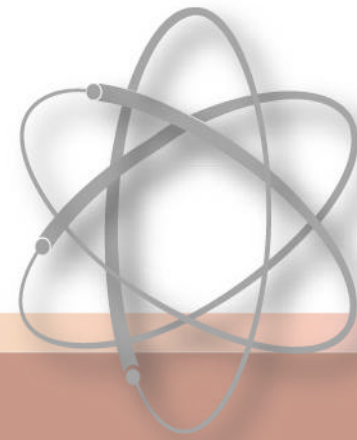
	<b>US SALES</b> \$ Billions	<b>US JOBS</b> Millions
<b>Radioisotopes</b>	<b>331</b>	<b>4.0</b>
<b>Nuclear Energy</b>	<b>90</b>	<b>0.4</b>
<b>Total</b>	<b>421</b>	<b>4.4</b>

**Highest global economic value from new and improved agricultural crop varieties:**

- Over 30 nations have developed >2000 new crop varieties
- 27% of all crops presently grown in China; 12% in India;

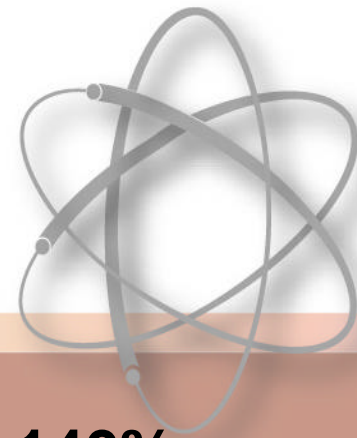


# Future needs for peaceful uses



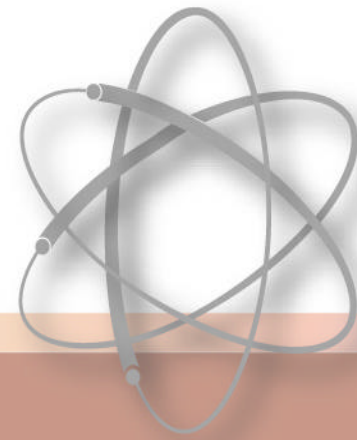
- Serve needs for major population expansion
- Remedy disparity of benefits between developed and developing countries
  - Electric power
  - Social needs served by other nuclear technologies

# Future Prospects for Nuclear Power



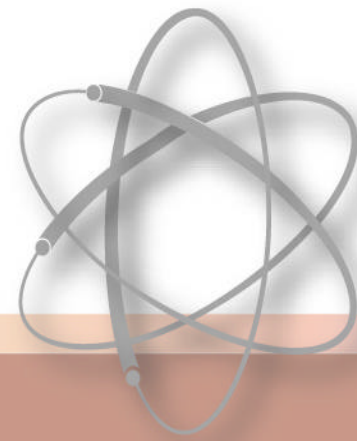
- **Global electricity growth ranges from 480%-140% by 2050 depending on economic growth rates (IIASA/WECC forecast)**
- **Large-scale source of power with essentially zero air pollutant and green house gas emissions**
- **Upgrades and license extension enhance value**
- **Systems of proven technology can be deployed in the near-term**
- **Advanced systems RD&D can expand scope of applications: industrial heat, hydrogen production, nuclear fuel sustainability**

# Challenges to Nuclear Power Expansion



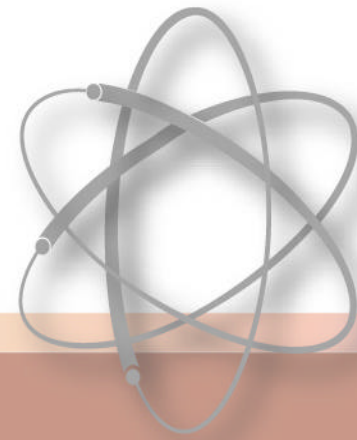
- **Cost competitiveness**
  - New plants at present are too costly
  - Economic gap greater for small reactors
  - Fossil fuel supply market volatility
- Public acceptance
- Spent fuel and radwaste management
- Weapons proliferation potential
- Security from terrorist threat

# Prospects and Challenges for Other Civilian Nuclear Technologies



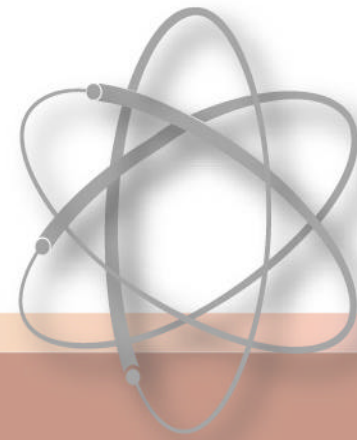
- **Wider market and greater scope of products anticipated**
- **Better public acceptance**
- **Proliferation from HEU-fueled research reactors and critical facilities**
- **Security of radioactive sources**
  - Potential for RDD use
  - Safety of orphan sources

# What Should Be Done



- **Define a collaborative international regime, that will foster a future economic contribution to energy and social needs, maintaining high standards of safety and proliferation resistance**
- **Strengthen export controls**
- **Provide international regional fuel services**
- **Government and industry must address challenges specific to each technology**

# CALL FOR ACTION FROM EXECUTIVE SUMMARY



- **It seems likely that nuclear technology will continue to evolve, not only in power generation and defense, but also in medicine, agriculture, and industry.**
- **Each possible nuclear technology path addresses different expectations, but each will bring its own difficulties. A problem-free nuclear future is not an option.**
- **Action must be taken to ensure that security comes first and that the nuclear future is what we choose, not the result of drift and inattention.**